

Looking for a needle in a haystack - How to search for bottom-up social innovations that solve complex humanitarian problems

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Looking for a Needle in a Haystack: How to Search for Bottom-Up Social Innovations that Solve Complex Humanitarian Problems*

Daniel J. Kruse[†] , Moritz Goeldner^{*†} , Katrin Eling , and Cornelius Herstatt

The worldwide increase in societal challenges is putting pressure on humanitarian organizations to develop sophisticated approaches to leverage social innovations in the humanitarian sector. Since humanitarian problems are complex problems, with the relevant knowledge being hidden, organizational search theory advocates the application of bottom-up and theory-guided search processes to identify the social innovations that solve these. Unfortunately, there has been no theoretical attention to understanding which approaches apply in this context. Further, established theory-guided bottom-up search processes, such as the lead user method, are unsuitable to the humanitarian sector, and we lack practice examples of adequate search processes. To start addressing this gap in theory and practice, procedural action research was done with the International Federation of Red Cross and Red Crescent Societies to develop a theory-guided bottom-up innovation search process for the real-life humanitarian problem of recurring floods in Indonesia. It revealed that an innovation search process for this context must differ significantly concerning its objectives and the steps to be taken from the lead user method, which was used as a starting point. Further, a comparison of the technical quality and the social impacts of the identified social innovations with social innovations identified through a non-theory-guided bottom-up search process (i.e., an innovation contest) suggests the superiority of this theory-guided search process. With this conclusion and the insights derived throughout the development of the search process, this study makes important contributions to theory development in the social and open innovation literatures and delivers important recommendations for social innovation practice in the humanitarian sector.

Practitioner Points

To enable effective innovation in the humanitarian sector, we provide the following theory-guided bottom-up search process (inspired by the lead user method) as a practical guide:

- Phase I: Project Scoping—Deciding on the project scope with all internal and external stakeholders supported by a boundary conditions matrix.

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- Phase II: Problem Understanding—Integrating various perspectives on the problem via pyramiding into a multidimensional problem space for an unanimous agreement.
- Phase III: Solution Search—Searching for solutions that address the problem space via pyramiding and complementary secondary research.
- Phase IV: Peer-Creation Facilitation—Facilitating networking (events) among social innovators with a similar problem perspective for a joint solution development.

Introduction

Through the worldwide increase in societal challenges, such as climate change, political instability, and economic volatility, there is increasing pressure on humanitarian organizations to professionalize and to develop sophisticated approaches to leverage social innovation (Eichler and Schwarz, 2019; OECD, 2011; Ramalingam et al., 2015). In the humanitarian sector, social innovation

can be defined as a novel solution to a humanitarian problem, such as a (temporary) lack of shelter or of drinking water that is caused by a natural disaster or by a political or a religious conflict (Ramalingam and Mitchell, 2014). Finding and leveraging solutions in this context is extremely challenging due to these

problems' specificity. On the one hand, humanitarian problems are complex, because they are highly local, context bound, time specific, and path dependent (Ramalingam, Jones, Reba, and Young, 2008). A solution's value thus depends on a complex pattern of for instance local and time-specific circumstances (Felin and Zenger, 2009, 2014). On the other hand, the knowledge that is required to successfully solve these complex problems is hard to find and to then transfer to humanitarian organizations, because especially the knowledge of local actors, who are directly affected by the problem, is most valuable (Hiwasaki, Luna, and Shaw, 2014). This *local* knowledge is specific to a culture and context and is often hidden and informally bound in local communities (Shaw, Sharma, and Takeuchi, 2009).

Due to these problem characteristics, unsurprisingly, there are claims of a paradigm shift, from a top-down "recipients of services" to a bottom-up "active participants" view on leveraging solutions to humanitarian problems (McGoldrick, 2015; Westley, 2008, p. 7). This would empower local communities to participate in developing the solutions to the problems they experience and thus to make best use of their knowledge (Brown, Donini, and Knox Clarke, 2014). Organizational search theory underpins this claim by advocating the application of search processes for social innovations in these problem conditions that are not only *bottom-up* but also *guided by theory* (Felin and Zenger, 2014). *Guided by theory* refers to a theoretical representation of the problem space that guides the search, usually by connecting a problem to the specific individuals that hold the specific knowledge required to solve complex problems (Lopez-Vega, Tell, and Vanhaverbeke, 2016; Rosenkopf and Nerkar, 2001).

Unfortunately, there has been very little theoretical attention to how innovative search takes place and which approaches apply in different open innovation contexts (Felin and Zenger, 2014; Lopez-Vega et al., 2016), particularly in a complex environment such as the humanitarian sector (Baumann and Siggelkow, 2013; Ramalingam et al., 2015). Clearly, the guiding theory in this problem context must differ from innovation searches established for typical consumer market problems, such as the search for market trend leaders who derive a personal benefit from finding a solution (i.e., the lead user method; von Hippel, 1986). Social innovators in the humanitarian sector rarely innovate in response to a market

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trend and often also not (only) for their own benefit, but are portrayed as citizens who innovate for the benefit of society (Harris and Albury, 2009; von Hippel, 2016). The research has not yet made it clear how a bottom-up search process for the humanitarian context should look and what the theory is that could guide searches.

As a result of this lack of knowledge about appropriate innovation search processes, humanitarian organizations are often “still trapped in a paradigm of predictable, linear causality” and top-down problem-solving structures (Ramalingam et al., 2008, p. vii), which means that “local and regional actors are of secondary importance” (Rihani, 2005, p. 56). To illustrate, in 2015, support for local and national NGOs accounted for only .4% of the overall international humanitarian assistance (Lattimer and Swithern, 2016). Thus, an internal search bias prevents these organizations from finding more suitable external solutions to innovation-related problems (Helfat, 1994; Martin and Mitchell, 1998). Further, there are few, if any, best practices that could be used as examples of a theory-guided search. Instead, to date, humanitarian organizations have relied on much simpler and fairly inexpensive to execute yet less suitable non-theory-guided approaches (i.e., innovation contests) to identify bottom-up social innovations (Rush et al., 2014).

To start addressing this research gap, and to overcome the problem of a lack of best practices that can be studied, our research team developed a theory-guided bottom-up search process for social innovations in the humanitarian sector using procedural action research (PAR) so as to answer the following research questions:

RQ1: What is an effective theory-guided bottom-up search process for social innovations in the humanitarian sector?

RQ2: Which theory could guide this search?

To this end, the authors worked with the International Federation of Red Cross and Red Crescent Societies (IFRC) in developing and applying such a search method for the real-life humanitarian problem of recurring floods in Indonesia. Further, to empirically prove the theoretical arguments that speak for the superiority of a *theory-guided* bottom-up search in the humanitarian sector, the results have

been benchmarked against the results of a non-theory-guided search method (i.e., an innovation contest) conducted by the IFRC in parallel to PAR with the same objective: to find solutions for recurring floods in Indonesia.

While our PAR research started like looking for a needle in a haystack, eventually, it has delivered new and important theoretical insights as well as first practical recommendations about how a theory-guided bottom-up search process for solutions to humanitarian problems should be designed and which theory could guide this search. Further, the benchmarking against an innovation contest has proven that *theory-guided* search does leverage higher-quality innovations.

Our study makes a number of important theoretical contributions to the open innovation literature generally, and specifically to the topic of open innovation in the social innovation domain. Concerning the general *open innovation* literature, our study adds first empirical evidence for theories in the search for bottom-up solutions in complex problem solving (Baer, Dirks, and Nickerson, 2013; Maggitti, Smith, and Katila, 2013); further, our findings contribute to the emerging body of research on the diffusion motives behind free innovation (de Jong, Gillert, and Stock, 2018); and we have responded to calls from the innovation governing literature to compare different open innovation search methods (Felin and Zenger, 2014; Savino, Messeni Petruzzelli, and Albino, 2017). Concerning the literature on *social innovation*, we present a first suitable open innovation search process that allows one to cope with the complexity in the humanitarian sector (Chalmers, 2013; Ramalingam et al., 2015), we offer new insights about social innovators' motives (Eling and Herstatt, 2017; Sinkovics, Sinkovics, and Yamin, 2014), and our findings underscore the importance of establishing networks and peer creation ecosystems in the social innovation context (Lettice and Parekh, 2010; Pulford and Addarii, 2010).

The remainder of this article is organized as follows. First, we present the theoretical background of this study, followed by the description of the PAR process and the presentation of the insights gained throughout this process. We then discuss the key insights in light of the existing literature and present the theoretical and practical implications as well as critical reflections on and the limitations of the PAR approach.

Theoretical Background

Social Innovation in the Humanitarian Sector

The humanitarian sector is a loosely connected global system in which various organizations, such as international agencies or NGOs as well as states, operate to respond to conflict situations or natural disasters, to enable livelihood support, and/or to resolve conflicts (Ramalingam and Mitchell, 2014). Current developments, such as climate change, political instability, population growth, and economic volatility, increasingly put pressure on humanitarian organizations to professionalize and to develop sophisticated approaches for leveraging social innovation (OECD, 2011; Ramalingam et al., 2015). Social innovation is an emerging research field with diverse definitions (Caulier-Grice, Davies, Patrick, and Norman, 2012) due to the many sectors in which this innovation type occurs (The Young Foundation, 2012). Most commonly, social innovation is defined based on its outcomes and in distinction to economic innovation (OECD, 2011; The Young Foundation, 2012), to (i) entail “a change in social relationships, -systems, or -structures,” and to (ii) focus on “a shared human need/goal or [...] a socially relevant problem” (van der Have and Rubalcaba, 2016, p. 1930). According to this definition, social innovation in the humanitarian sector is a solution to a humanitarian problem that involves changes to existing social relationships, systems, or structures.

We will now explain why processes to leverage social innovation in the humanitarian sector should, from a theoretical perspective, be *bottom-up* and *theory-guided*. To this end, we follow organizational search theory, which is central to innovation theory (Laursen, 2012; Nelson and Winter, 1982) and considers innovation as a problem-solving activity that depends on a search for and the recombination of knowledge (Felin and Zenger, 2015; Nickerson and Zenger, 2004; Savino et al., 2017). According to organizational search theory, applying the right search approach is essential for identifying the relevant knowledge, if one is to innovate successfully (Katila, 2002; Weitzman, 1998). Our argumentation is based on Felin and Zenger’s (2014) theoretical framework, which links the selection of the search process for innovation to two key dimensions of a problem. These dimensions are (i) the degree of *hiddenness* of the knowledge that is deemed relevant to solve the problem, which entails an authority-based (top-down) versus a user-directed (bottom-up) search

and by (ii) the problem’s degree of *complexity*, which relates to either a (simple) trial-and-error or a (complex) theory-guided search.

Hiddenness of Knowledge Advocates a Bottom-up Search Approach

Estimates suggest that only 10% of survival in humanitarian emergencies can be ascribed to external sources of relief aid (Bankoff, Frerks, and Hilhorst, 2004). Instead, local knowledge and solutions are crucial for solving humanitarian problems (Hiwasaki et al., 2014; Jones, 2012), particularly in the case of flood-related disasters (Wilby and Keenan, 2012). Thus, to improve their innovation capabilities, humanitarian organizations must increase the variety of their knowledge sources and, particularly, need access to *local* knowledge, distant from their current, internal knowledge base (Laursen and Salter, 2006; West and Bogers, 2014).

Here, *local* knowledge refers to the knowledge of (groups of) individuals, communities, or organizations that provide on-site “protection and assistance [...] outside of the formal humanitarian system,” thus, independent of the formal section in which humanitarian organizations operate (IFRC, 2015, p. 152). Concerning every socio-political context, the humanitarian sector’s institutional architecture is configured by a complex assembly of *formal* national or regional institutions and rules, such as governmental regulations or property rights, and (often locally bound) *informal* traditions, norms, or customs (Mair, Marti, and Ventresca, 2012; North, 1991). It is hard to identify local knowledge, since it tends to be specific to culture and context, is locally bound, is mostly orally transmitted, and is embedded in the informal section (Shaw et al., 2009), which matches the concept of *hidden* knowledge (Felin and Zenger, 2014). Further, in this setting, the transfer of hidden knowledge is complicated by institutional voids, which appear when formal institutions are absent or weak and cause market constraints (Rivera-Santos and Rufin, 2010; Schuster and Holtbrügge, 2014). This fits the definition of social innovation as “inspired by the desire to meet social needs which can be neglected by traditional forms of private market provision and which have often been poorly served or unresolved by [...] the state” (Harris and Albury, 2009, p. 16). Thus, local knowledge is “sticky” (von Hippel, 1998), i.e., it is non-obvious information that is hard and costly to transfer from the

local communities to formally operating humanitarian organizations (Saxena, 2015).

Due to this hiddenness and stickiness of knowledge relating to humanitarian problems, humanitarian organizations are advised to apply bottom-up problem-solving approaches known under the umbrella term open innovation to acknowledge the capabilities of locals, who possess relevant hidden and sticky knowledge outside the organization's boundaries (Jeppesen and Lakhani, 2010; Lopez-Vega et al., 2016; von Hippel, 1998). It is only in this way that organizations can overcome their internal search bias, which prevents them from finding alternative, external solutions to humanitarian problems (Helfat, 1994; Martin and Mitchell, 1998). This notion is in line with the call for a paradigm shift (Bloom and Betts, 2013; McGoldrick, 2015), from top-down “recipients of services” to bottom-up “active participants,” so as to build resilience to humanitarian problems (Westley, 2008, p. 7).

Problem Complexity Advocates a Theory-Guided Search Approach

The open innovation toolbox contains a diverse set of approaches that seek to integrate bottom-up knowledge into an organization (Bogers et al., 2017; Felin and Zenger, 2014), such as co-creation, innovation contests (Afuah and Tucci, 2012; Jeppesen and Lakhani, 2010), or the lead user method (Lilien, Morrison, Searls, Sonnack, and von Hippel, 2002; von Hippel, 1986). However, theoretically matching the search approach for external knowledge to the innovation problem type at hand (Felin and Zenger, 2014) excludes many established bottom-up approaches for the humanitarian sector.

Ramalingam et al. (2008) emphasized the nonlinear relationship between problem causes and effects in the humanitarian sector and the highly local, context-bound, time-specific, and path-dependent nature of humanitarian problems. For example, the humanitarian problem of lacking drinking water can have different drivers such as a natural disaster, political conflict, or institutional voids, and can have different severity levels depending on (i) the existence and interrelatedness of different subproblems, such as pollution in a well or being isolated from supermarkets or aid shipment, as well as on (ii) the exact location and problem duration. Humanitarian problems can thus be classified as complex innovation problems in Felin and Zenger's (2014) theoretical framework.

According to this framework, complex innovation problems require a theoretical representation of the solution landscape that guides the search (Macher, 2006). Only small deviations in an innovator's knowledge set from the specific knowledge required to solve the problem can decrease the value of the solutions developed by this innovator (Felin and Zenger, 2009). For example, an innovator living in an urban area may not fully understand the problem of a lack of drinking water in a neighboring rural village during a flood disaster. Thus, a simple broadcasting of solutions through innovation contests and similar approaches is less suitable (Felin and Zenger, 2014; Stockstrom, Goduscheit, Lüthje, and Jørgensen, 2016). In contrast, for simple problems, the solution space is much wider, increasing the likelihood of finding a valuable solution. This allows for a broadly disseminated invitation to anyone who deems his or her knowledge relevant to self-identify as an innovator.

This notion of a theory-guided search fits the suggestion to apply open innovation search methods that identify and select specific individuals who carry specific knowledge concerning solving a specific innovation problem (Franke, von Hippel, and Schreier, 2006; Lopez-Vega et al., 2016). Generally, these individuals that hold the relevant knowledge to come up with solutions to a very specific problem such as a humanitarian problem constitute only a small fraction of the entire population and are therefore hard to find (Stockstrom et al., 2016). The most well-known and established search method to identify such specific individuals is the lead user method (Lüthje and Herstatt, 2004). It builds on the theoretical assumption that there are so-called lead users who, besides deriving a personal benefit from their solution, are characterized by their trend leadership (von Hippel, 1986). Thus, the lead user method starts by collecting knowledge on relevant market trends. The subsequent trend selection can then be constituted as the guiding theory for searching for individuals who have already developed solutions for the problems relating to this trend.

Which Theory Guides the Search in the Humanitarian Sector?

The search for individuals who have developed solutions to the complex problems in the humanitarian sector cannot yet be guided by a clear-cut theory, because neither the problem space nor the innovator characteristics are well enough understood. From a problem

space perspective, which is the usual starting point in the lead user method (i.e., searching for a trend means searching for future problems and needs), social innovations in the humanitarian sector are unlikely to be developed in light of a market trend. The only trends that can be identified are mega-trends, such as climate change or urbanization, which cause or exacerbate existing humanitarian problems. In comparison to a specific market trend in a typical consumer market context, however, these mega-trends are global and lack a direct connection to the local level (Asprone and Manfredi, 2015), where the actual humanitarian problems are situated (i.e., a lack of drinking water caused by the flooding of a well with polluted water due to unusually heavy rain due to climate change). Thus, these mega-trends cannot be used as a guiding theory to identify solutions that are relevant at the local level.

From an innovator perspective, which is the other facet of the guiding theory for the lead user method, social innovations are associated with a wide range of actors (The Young Foundation, 2012; van der Have and Rubalcaba, 2016) known as social entrepreneurs (Bacq and Janssen, 2011), institutional entrepreneurs (Dorado and Ventresca, 2013), or social innovators (Mulgan, Tucker, Ali, and Sanders, 2007). Thus, a search in the humanitarian sector is likely to surface a diverse range of innovators that may be based in the public, private, or third sectors and may in fact not only be individuals (such as users or citizens), but also communities of innovators (Harris and Albury, 2009). Further, such social innovators can be expected to develop useful bottom-up social innovations in relation to the needs of their community or even beyond, instead of only innovating for their personal benefit (von Hippel, 2016). As a result, searching for innovators with a specific characteristic, such as a high own benefit, is also not a useful starting point. Instead, existing research indicates a high diversity rather than many similarities among social innovators in the humanitarian context.

Thus too little is known about a theory that can guide a bottom-up search for social innovations in the humanitarian sector. Further, the literature has not made it clear how a theory-guided bottom-up search process in this context should best look. Clearly, the only well-known theory-guided search process for “user community-directed innovation” (Felin and Zenger, 2014), i.e., the lead-user method, which focuses on market trend leaders with a high own benefit from their solution, is unlikely to be suitable in the humanitarian sector. We thus expect that a number of

adaptations to this method are required. To find out which adaptations to this search process are necessary, our research team has applied PAR to the real-life humanitarian problem of recurring floods in Indonesia with the IFRC. Also, to empirically support the arguments for the need for a theory-guided search process, we have quantitatively benchmarked the developed search process’ results against a broadcasting search.

Methodology

Action research “is an orientation to knowledge creation that arises in a context of practice and requires researchers to work *with* practitioners” (Huang, 2010, p. 93). Several scholars have pointed out action research’s ability to address complex issues, which makes it especially suitable for the complex humanitarian context (Altrichter, 1991; Davis and Sumara, 1997; Green, 1999; Phelps and Hase, 2005). Conventionally, action research approaches require a researcher to play an extremely immersive role (Warmington, 1980) by collaboratively formulating and solving a problem with practitioners. We applied a less immersive form, i.e., *procedural* action research (PAR), which focuses less on the diagnosis of a problem (Platts, 1993). While the researchers still develop and test a solution with their industrial partners, they start with a previously identified problem (Moultrie, Clarkson, and Probert, 2007). Thus, PAR seeks to both (i) provide practical support to the collaborating organization and (ii) develop theory from the insights gained throughout the PAR process (Maslen and Lewis, 1994). Thus, using a PAR approach is especially suitable where both best practice procedures and theory are lacking and thus still need to be developed.

We executed PAR with the IFRC, with the intention to develop a theory-guided and bottom-up search process to surface social innovations that address the humanitarian problem of recurring floods in Indonesia. PAR was implemented by three of the authors between October 2016 and February 2017, while the final evaluation and related theorizing was conducted by all four authors. During the implementation, the executing authors went to Indonesia twice, first for a kick-off workshop in Jakarta and initial expert interviews, and second for a two-week field trip and to co-organize the first Flood Resilience Innovation Conference in Jakarta, which also constituted the project’s completion. Another workshop was held with the IFRC management and selected experts between these two

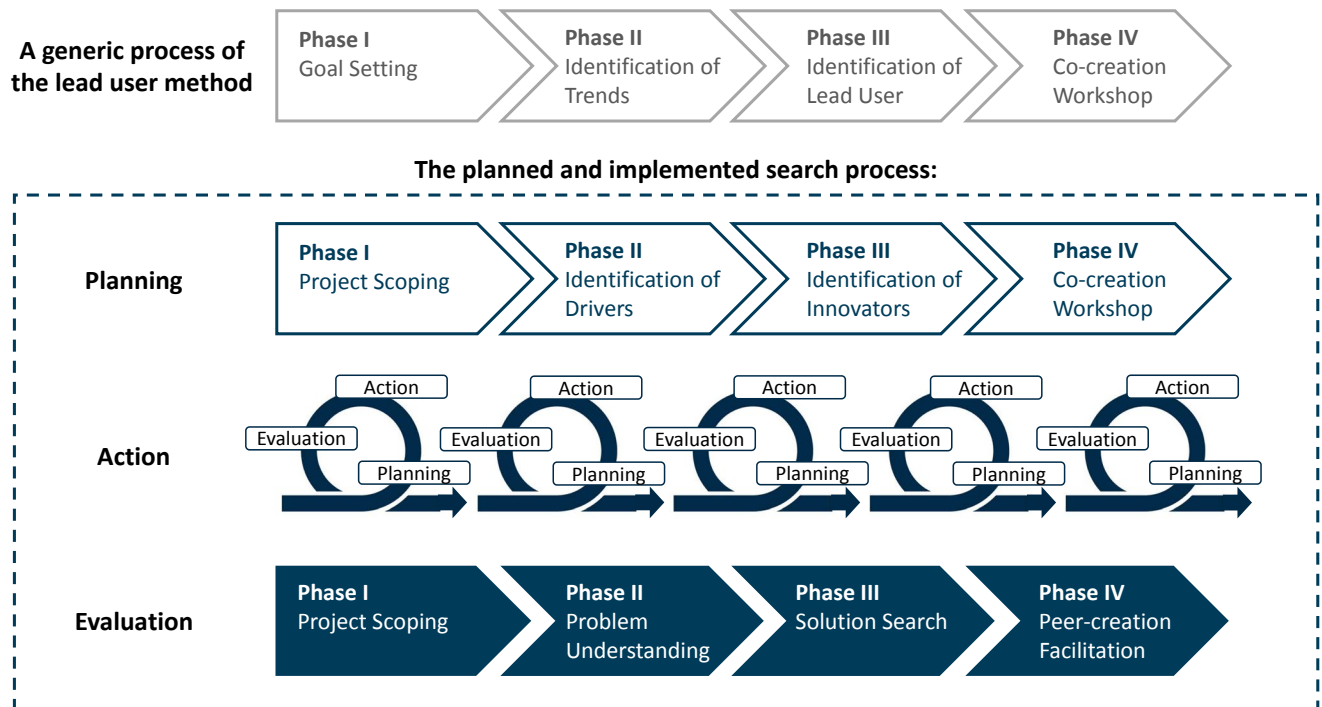


Figure 1. The Four Phases of the Lead User Method (see e.g., Lilien et al., 2002; Lüthje and Herstatt, 2004) as Well as the Planning, Action, and Evaluation Cycles of the Planned and Implemented Search Process. [Color figure can be viewed at wileyonlinelibrary.com]

events in Geneva at the IFRC's headquarters. All other tasks were executed from Germany, with regular calls with IFRC staff in Geneva and Jakarta. A translator (Bahasa Indonesia to English) assisted the team along the study. In parallel and in the same timeframe as the PAR, the IFRC conducted an innovation contest on the problem of recurring floods in Indonesia with the local Indonesian Red Cross (Palang Merah Indonesia/PMI). Both teams were supervised by the same senior IFRC innovation manager.

Every PAR typically consists of “multiple action research cycles operating concurrently” (Greenwood, 2014, p. 12) and iteratively in every single phase. One PAR cycle is then composed of three phases: planning, action, and evaluation (Gill, Johnson, and Clark, 2010; Greenwood, 2014; Susman and Evered, 1978). We also cycled several times through these three phases throughout the study (for an illustration, see Figure 1), as also described in the PAR Action section. For reasons of readability, we summarize the original up-front planning in the PAR Planning section and summarize the overall insights derived through the PAR in the PAR Evaluation section. We critically reflect on the PAR process (Huang, 2010; Levin, 2012) in the final section of this article, Critical Reflection and Limitations.

PAR Planning

While we used the lead user method as the only well-known theory-guided bottom-up search process (Felin and Zenger, 2014) as a reference point, from the start, we made a number of adaptations to the generic four phases (Churchill, von Hippel, and Sonnack, 2009; Lüthje and Herstatt, 2004; von Hippel, 1986) to account for the humanitarian sector's characteristics.

Phase I: Goal setting became project scoping. According to the guidelines for the lead user method, we sought to build an interdisciplinary team and have a joint workshop to define the project goals together. From the beginning, however, we expected a higher number of more diverse stakeholders compared to a common lead user project and a bigger need to scope down the project's direction due to the many types of recurring floods and the many regional differences.

Phase II: Identification of trends became identification of drivers. Since global mega-trends such as climate change are too broad to guide a search, we planned to focus on the interconnections between such global mega-trends and local humanitarian problems

by identifying specific drivers of floods in Phase II. We planned to conduct a local search using secondary research and by interviewing experts from the IFRC as well as external experts on the drivers of floods in Indonesia.

Phase III: Identification of lead users became identification of social innovators. Throughout the identification phase, we planned to apply pyramiding search and the screening approach concerning the drivers detected during Phase II to identify a set of social innovators (instead of lead users) who have already developed solutions to recurring floods.

Phase IV: Co-creation workshop. Our aim for Phase IV, similar to the generic lead user method, was to conduct a co-creation workshop with the identified social innovators and IFRC staff to further develop selected innovations and to co-create new solutions together.

PAR Action

We will now describe the execution of the PAR (i.e., the action), which problems occurred during the execution (an evaluation step), and how we reacted to these problems and thus adapted the innovation search process accordingly (a re-planning step).

Phase I: Project scoping. Already during an initial local search, it became clear that the planned scoping and mutual agreement on clear project goals would be dogged by a wide range of definitions and diverse terminologies about the problem context. This was also reflected in a wide range of different perspectives from various stakeholders that constitute the IFRC as a multinational and multidisciplinary organization. To seize the potential for innovation of these internal and external knowledge sets (Ancona and Caldwell, 1992), we used a boundary conditions matrix that illustrates nine dimensions of flood resilience as boundary conditions, which inspired a fruitful discussion among all stakeholders (mostly IFRC and PMI staff), leading to an agreement on the overall project scope.¹

¹These dimensions distinguished for instance between different flood types (pluvial, fluvial, and coastal), protection priorities (humans, infrastructure, cultural assets, etc.), and affected area types (urban, semi-urban, and rural).

Phase II: Identification of drivers became problem understanding. In Phase II, we saw that the usual search for trends in a market is indeed not suitable for the humanitarian sector. Instead, we started perceiving floods as a problem with various interrelated causes as part of a complex system. As such we started to use pyramiding not only for the purpose of identifying innovators in Phase III (Lüthje and Herstatt, 2004; Poetz and Prügl, 2010), but also for getting recommendations on where to find other experts to receive manifold perspectives on this complex problem (Stacey, 2003). Pyramiding is based on the idea that experts in a field know one another and has been proven to be more effective than mass screening in identifying individuals with specific characteristics (Stockstrom et al., 2016).

With staff members from the IFRC and PMI, we approached 210 experts, received 116 responses (a 55.2% response rate), and conducted 48 semi-structured expert interviews² (mostly via phone) with respondents from 11 countries working for governments, NGOs, universities, and companies (for an overview of the experts, see Online Supplement 1 in supporting information). During this process, we analyzed and discussed our interview notes iteratively with regard to new insights that occurred along the way (Poetz and Prügl, 2010) concerning causes of floods and how they can be categorized. We used inductive coding to derive macro global and micro local causes, which we summarized in an illustration of a two-dimensional problem space (see Figure 2). This illustration worked as the comprehensive problem formulation in which we integrated various views using theoretical saturation on mentioned causes as an indicator of when to stop (Baer et al., 2013).

To illustrate our process of understanding the problem complexity, the interviews revealed multiple causes of floods in Indonesia, such as climate change:

Climate change is the most driving factor of floods in Indonesia. (expert from a company in Jakarta, Indonesia)

²We used a semi-structured interview guideline with six leading questions and a set of subquestions. We asked, for instance: *From your perspective, what are the most important causes of flooding in Indonesia?, What are the underlying reasons?, Have you ever come across an innovative idea/concept/solution/technology for improving flood resilience in a rural or semi-urban setting in Indonesia?, From your point of view, who are the three most relevant flood resilience experts in Indonesia?*

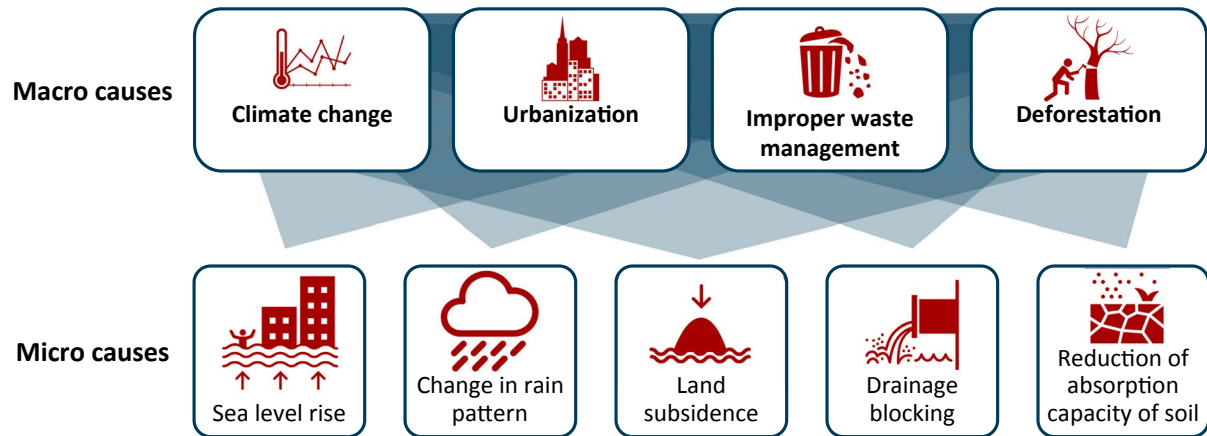


Figure 2. Problem Formulation Illustrated as a Problem Space Consisting of Macro and Micro Causes of Floods Based on Expert Interviews. [Color figure can be viewed at wileyonlinelibrary.com]

Prediction of rain season and flooding was easier in former days. (expert from an NGO in Jakarta, Indonesia)

In contrast, other experts pointed to different viewpoints on climate change's impacts:

Floods are primarily manmade, not due to climate change. (expert from a government agency in Bangkok, Thailand)

For instance, in Bandung there had been a lake in the city which was converted into settlement resulting in more crucial flood problems. (expert from an NGO in Jakarta, Indonesia)

Throughout the interviewing process, we also recognized many different subcauses and the various interconnections among them, including the interconnection of improper waste management and a lack of drainage systems (and their maintenance):

Waste is a problem, as it hinders the river from flowing in its usual way. Also, the drainage systems are either not in place or not well maintained. (expert from an NGO in Jakarta, Indonesia)

In view of the many subcauses and their interconnectivity, we started realizing that we had underestimated the complexity of the problem of recurring floods. Thus, we significantly expanded the duration of Phase II so as to comprehensively formulate the problem at hand and to distinctively separate this task from the following

phases. The latter was necessary so as to avoid being *solution-minded* (Maier and Hoffman, 1960) and swiftly jumping to solutions without first assessing a solution's value for the problem (Enders, Andreas, and Barsoux, 2016). Further, to get to agreement on a comprehensive problem formulation, we decided to conduct a joint workshop with all participants from the kick-off workshop and the IFRC management at the end of Phase II. In this workshop, we discussed all causes of floods in Indonesia until we reached unanimity instead of a simple majority decision (Baer et al., 2013). To inspire this discussion and foster the problem understanding, we used the visual illustration of the problem space as derived from the interviews (see Figure 2) as a comprehensive problem formulation ("phase space"; see, e.g., Ramalingam et al., 2008). Especially the layer with micro-causes was meant to provide addressable starting points for finding potential solutions (compared to macro-causes such as climate change or urbanization; MacCrimmon and Taylor, 1976; Reitman, 1964; Taylor, 1975).

Phase III: Identification of social innovators became solution search. In Phase III, contrary to our planning, we focused on searching solutions along the problem space and the related micro-causes that we agreed on at the end of Phase II, instead of searching for specific innovators, as is the intention of Phase III of the lead user method. We learned this through two problems we encountered along the way. First, the screening approach—in the form of a short survey broadly disseminated in the vast volunteer network of the Indonesian Red Cross—was unsuccessful. This survey was conducted in two languages (Bahasa

Indonesia and English) and focused on recurring floods in Indonesia and on innovators who had developed solutions to address this problem. Although the survey generated 156 responses, we did not identify a single innovator.

Second, our pyramiding search for social innovators often yielded only indirect referrals to organizations, events, literature, or solutions—instead of direct referrals to individuals, as expected (Stockstrom et al., 2016; von Hippel, Franke, and Prügl, 2009). For instance, many experts could point to an NGO or university that they knew was competent in the flood risk reduction field due to projects implemented by these organizations. Thus, we had to complement a pyramiding search with intensive secondary research so as to close these gaps. To illustrate, an expert from a travel book publisher from Berlin, Germany, who has traveled extensively in Indonesia, directed us to traditional floating houses on the Kalimantan island of Indonesia. Thus, we searched for floating houses in Indonesia and found a state-of-the-art floating library in the city of Semarang (Java Island), whose float was made from 30% plastic waste bought from waste scavengers. In this area, subsidence of land and clogged drainage systems due to plastic waste are major drivers of floods, which are both addressed

by this social innovation. The local government decided that a floating public space would need less maintenance in the long run than regular houses.

In sum, as Figure 3 visualizes, we identified 35 of 48 interviewees via pyramiding (i.e., referrals from previous interviewees, referrals from IFRC, or referrals from intermediaries we contacted). These interviews directed us to 14 of 25 social innovations in the sample, while the remaining 11 social innovations could be assigned to secondary research. Further, Figure 3 also shows that we found most of the social innovations after we agreed on a problem space with the IFRC at the end of Phase II.

Toward the end of Phase III, we conducted an 11-day field trip across Indonesia to meet and interview five innovators and four experts, and visit the above-mentioned floating library and five flood-prone villages, where we encountered five social innovations. During these visits, we had a major insight. Due to the experience of floods as a usual aspect of daily life, we learned first-hand what an expert from Delft University of Technology (the Netherlands) had meant by the ambiguity of the coping strategy “living with the floods.” On the one hand, this fatalism can be a useful strategy to cope with a daily life problem, even leading to creative solutions (Liao, Le, and Van Nguyen, 2016); on the other hand, it prevents change:

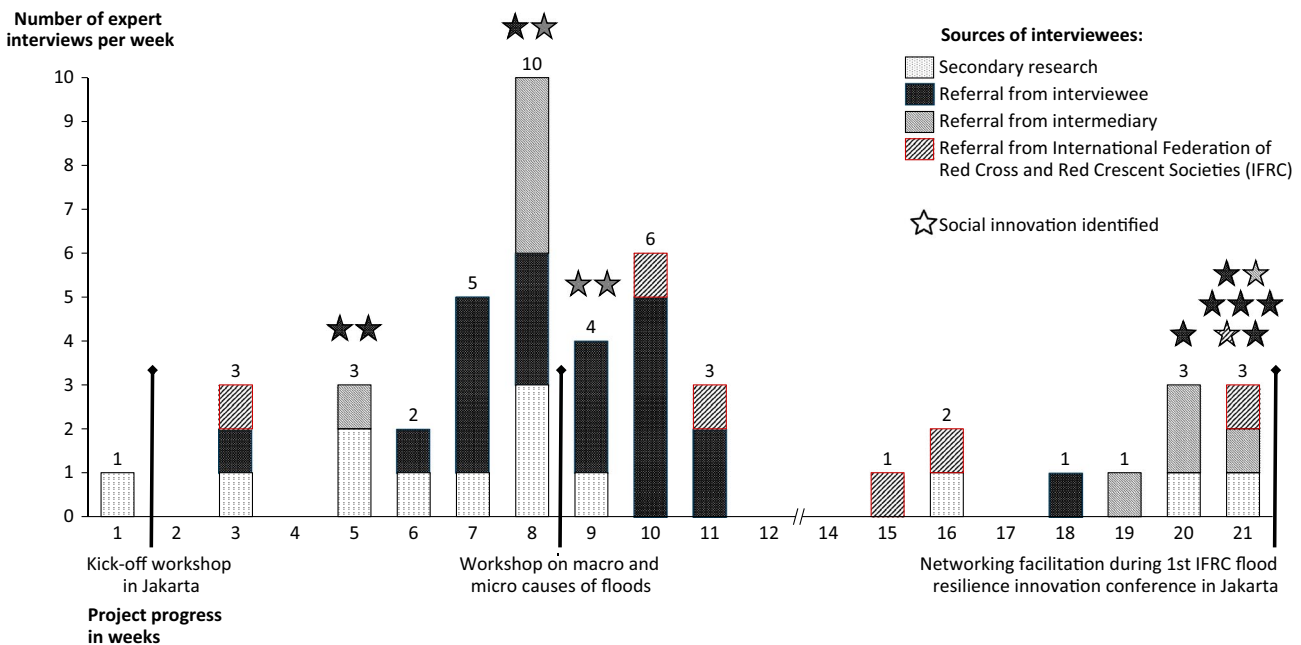


Figure 3. Pyramiding During the Course of the Project: Sources of Interviewees and Sources of Social Innovations Identified. [Color figure can be viewed at wileyonlinelibrary.com]

Not everyone acknowledges that there is a problem. Many people are used to floods and their fatalism prevents them from changing something. (expert from a company in Jakarta, Indonesia)

This made us realize how useful and necessary even simple low-tech solutions such as elevated sidewalks or swimming gardens are in these living conditions. Further, the incrementality of these social innovations (Neumeier, 2012) explains why individuals and communities develop ways to live with floods without considering their adaptations of everyday products as social innovations or themselves as social innovators (Lettice and Parekh, 2010).

Phase IV: Co-creation workshop became peer-creation facilitation. During our field trip to the flood-prone villages, we were again made aware of the fact that affected people know best how to address the complex problems that directly affect them. Based on our learnings over the course of PAR, we realized that identifying social innovators in order to develop new solutions with them in a co-creation workshop contradicts this basic notion. The identified innovators all had very different perspectives on the problem of floods in Indonesia and, thus, developed very different solutions. Achieving a knowledge transfer that would allow them to jointly work on and agree on an optimal new solution appeared impossible, since this knowledge is sticky and thus hard to transfer (von Hippel, 1994). As an expert from Delft University of Technology (the Netherlands) noted: *there is no silver bullet for flood resilience.*

Thus, in contrast to our planning, we refrained from implementing a co-creation workshop; instead, we encouraged the facilitation of peer creation through knowledge transfer among peers during Phase IV. As a reaction, we co-organized the first Flood Resilience Innovation Conference in Jakarta, with the IFRC and the Indonesian Red Cross, to foster local knowledge transfer (i) among social innovators with a similar problem orientation and (ii) within the network of the IFRC and the local Red Cross (such as NGOs, investors, and local governments). Nine of 25 social innovations we identified were presented by the originators during the two day event in Jakarta.

PAR Evaluation

In the PAR Action section, we described the evaluation and (re-)planning cycles within the process. We

will now present a summary of our insights about (i) the resulting search process, (ii) the characteristics of the identified innovations and innovators as potential indications for what to search for, and (iii) a comparison of a theory-guided search with a broadcasting search.

The resulting theory-guided bottom-up search process. Based on our PAR, a theory-guided bottom-up search process for social innovations in the humanitarian sector should consist of four phases (Figure 4): project scoping, problem understanding, solution search, and peer-creation facilitation.

- *Phase I: Project Scoping.* A goal-setting for the future involvement of the still-to-be-found social innovators, as is common for the lead user method, reflects simple assumptions in market environments that do not apply to the humanitarian sector. Instead, in this phase, a workshop should gather all relevant internal, and especially external, stakeholders from analogous fields in order to achieve a general project scoping.
- *Phase II: Problem Understanding.* Instead of searching for market trends as it is undertaken in the lead user method, this phase should apply an overall problem formulation perspective (Baer et al., 2013; Nickerson and Zenger, 2004). Pyramiding search is a valuable tool for accessing various multidisciplinary perspectives on this problem and thus ultimately grasping its complexity. We also learned that it is very helpful to illustrate the problem space according to macro-causes and micro-causes derived through the inductive coding of expert interviews.
- *Phase III: Solution Search.* A clear distinction between problem understanding (Phase II) and solution search (Phase III) is necessary to understand the problem comprehensively and avoid jumping hastily to solutions, thereby risking the solving of the wrong problem or focusing only on symptoms. In this regard, a comprehensive problem understanding should guide the search for solutions rather than for social innovators. The de facto search for solutions is best carried out via pyramiding search and complementary secondary research.
- *Phase IV: Peer-creation Facilitation.* Co-creation between an organization and innovators, as the lead user method's ultimate goal, is not suitable for the humanitarian sector. Instead, a humanitarian organization is advised to encourage the facilitation of

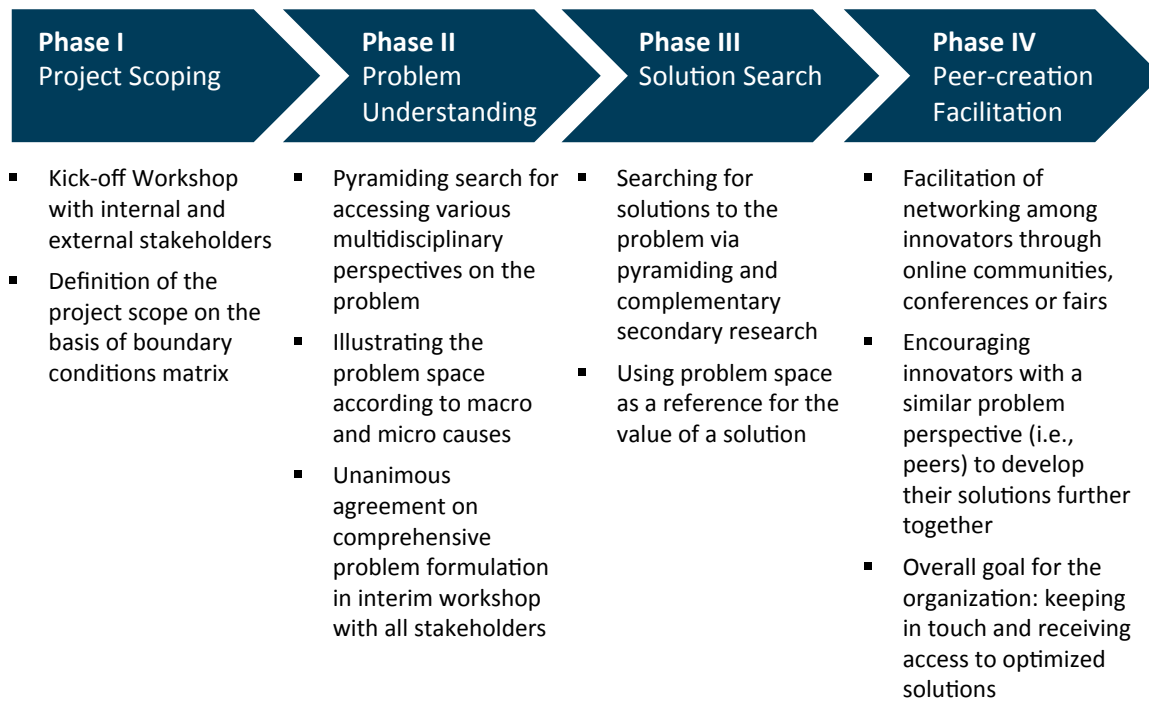


Figure 4. Final Result of the Theory-Guided Bottom-Up Search Process. [Color figure can be viewed at [wileyonlinelibrary.com](#)]

peer creation via knowledge transfer among like-minded peers with a similar problem orientation in Phase IV.

The characteristics of the innovations and the innovators. As potential indicators for a theory to guide the search, we will present our insights on the characteristics of the innovations and the innovators identified by the developed innovation search process (for a complete overview, see the Appendix). Concerning the innovations, our theory-guided bottom-up search yielded 25 social innovations. We clustered the innovations into seven categories, as shown in Table 1. Most identified solutions were not tangible products, but a mix of different types, with the majority being nature-based, community-based, or grassroots. Concerning the disaster risk management (DRM) cycle,³ most of these solutions were aimed at flood risk prevention, while established players in the humanitarian sector tend to focus on disaster response or recovery. The DRM cycle has four phases: two pre-disaster (prevention and preparedness) and two post-disaster (response and

rehabilitation) phases (Alexander, 2002, p. 6). We found that the innovations in our data set mostly addressed prevention (17), followed by preparedness (6), rehabilitation (3), and response (4).⁴ Finally, we analyzed whether and how the social innovations had already been adopted by others. Two of the social innovations were available as prototypes. Nine of the sample concepts were being used within the local community. Seven social innovations were available to several villages in one province and another seven were already being used in several of Indonesia's 34 provinces.

Looking at the innovator characteristics, we merely recognized commonalities concerning the social innovators' motives. An interesting theme is that a severe, potentially life changing event may trigger innovative endeavors by individuals to develop a social innovation. A geology Ph.D. student experienced a disastrous landslide that caused the death of a colleague. With this loss in mind, he decided to develop a simple, cheap rainwater measurement device that acts as an early warning system for landslides:

³The disaster risk management cycle is a simplified model of the activities chain before and after a catastrophic event such as a flood (Alexander, 2002).

⁴Some innovations fit into two phases of the DRM.

I just had to do something [...] People need to know when the risk of landslides is increasing, so as to be able to remain alert. (developer of social innovation 1)

For 11 concepts, the trigger was such a personal need on the part of innovators. In eight cases, the innovators recognized a need at work; most of them were working for an NGO in the humanitarian sector. For instance, a social innovator noted:

Working in the development sector for many years, we saw a big missing link in information flow from person to person at the base of the economic pyramid. We saw this as an opportunity to really release technology and solutions that existed in that area. (developer of social innovation 10)

Thus, she developed an app that provides its users a social and hyperlocal ecosystem in which they can exchange information about hazards such as floods or other related everyday topics. The use of Vetiver grass is another example of a work-related trigger: During his work for his self-founded NGO, a British-born civil engineer was in search of a multifunctional, nature-based, and replicable solution that would allow him to stabilize roads in a steep environment despite regular flooding and the accompanying soil erosion. During his search, he became aware of Vetiver grass—a permanent fast-growing clump grass with a dense root system penetrating to at least three meters, thus forming a dense, permanent hedge that prevents soil loss. While he and his team used the Vetiver grass at the beginning only in their own NGO's work, he soon found that he could even sell Vetiver grass plants to companies or the government in Indonesia in order to subsidize their own NGO.

In the remaining six cases, the social innovation was born because individuals identified institutionally unmet needs. For instance, an innovator experienced how important education is when she was in a train and witnessed a mother telling her child to throw garbage out of the window. Building on this, she developed a board game that educates children (and their parents) about environmental issues.

We found that 18 of 25 social innovations were developed by the innovator in their unpaid discretionary time. The remaining seven social innovations were developed within a firm, in most cases as part of their job in an NGO.

Nineteen of 25 social innovations were revealed for free, i.e., the innovation is available to others without payment. Some innovators revealed open-source manuals on how to rebuild a device, while others invited members of their own or adjacent communities to visit the own social innovation to potentially rebuild it. The remaining six social innovations were not revealed freely, mostly because they were developed within an organization whose business model would not allow the diffusion of the innovation for free. Von Hippel (2016, p. 1) defined free innovation as a “functionally novel product, service, process, or application, developed by consumers at private cost in their unpaid discretionary time and is not protected by the developer.” Thus, 16 innovations can be labeled *free innovation*.

Comparison to broadcasting. To test the claimed superiority of a theory-guided search process over a mere bottom-up broadcasting one, we compared the identified solutions to the submissions to the innovation contest executed by the IFRC and PMI. First, the fact that we discovered no overlap between the 25 innovations surfaced from our theory-guided search process and the 60 submissions to the innovation contest indicated that the two approaches surfaced different solutions.⁵ Looking closely at the categories (Table 1), we see that some are distributed fairly similarly between the two approaches (nature-based solutions: 20% versus 17%), while others differed considerably (tangible products: 12% versus 43% or grassroots solutions: 20% versus 2%).

For the quantitative comparison, all innovations were assessed by four senior experts from the humanitarian or engineering sector with extensive market and technical knowledge in their sector.⁶ For the assessment, all innovations were equalized in terms of the amount of text (150 to 200 words), were blinded concerning the source, and were presented to the experts one by one in random order. To assess the innovations' quality, we were interested in two perspectives.

⁵For selected examples from both theory-guided search and broadcasting (benchmark), see Online Supplement 2 in supporting information.

⁶One expert was a well-known researcher from the Indonesian Institute of Geophysics and Meteorology, one a member of the IFRC from the Disaster and Crisis (Prevention, Response, and Recovery) Department, one the director of the German Committee for Disaster Reduction, and one the former head of the World Meteorological Organization's Food Forecasting and Management Division with extensive knowledge on Southeast Asia. All four experts were not part of the pyramiding search in Phase II and were also not originators of a social innovations in Phase III.

On the one hand, we wanted to assess their quality based on three established criteria for assessing the technical quality of innovation ideas in typical consumer market domains: *novelty*, *use value*, and *feasibility*. A concept's novelty (or originality) is associated with the extent of innovation: incremental innovations have lower novelty and radical innovations higher novelty (Magnusson, Wästlund, and Netz, 2016). Use value specifies a solution's ability to actually solve the problem it addresses (Amabile, Conti, Coon, Lazenby, and Herron, 1996). Feasibility is a criterion to assess how easily a concept could translate into a commercial product, considering both technical and economic aspects (Magnusson, 2009). Using the mean value of these three variables, we calculated the value of each concept's technical quality.

On the other hand, given the humanitarian problem context, we were interested in the innovations' social impacts as well as in their degree of elaborateness as an indicator of ease of implementation (IFRC, 2011). We measured the *degree of elaboration* using an established measure (Piller and Walcher, 2006). Due to missing metrics for the assessment of an innovation's social impact (Antadze and Westley, 2012), we distinguished three criteria as a result of five additional expert⁷ interviews and a comparison to the literature (Balkema, Preisig, Otterpohl, and Lambert, 2002; Domínguez-Torreiro, 2016; Hutton, 2000; Mulgan, 2010; United Nations, 2014): *cost-effectiveness*, *practicality*, and *social inclusiveness*. Cost-effectiveness is a popular measure in this context: it considers how well inputs (i.e., funds, people, material, and time) are used to undertake activities and are converted into results (Antadze and Westley, 2012; Balkema et al., 2002; Hutton, 2000). Practicality is the ease of implementing a concept concerning the beneficiaries' capacities (Clifford, 2014; IFRC, 2016). Practicality and cost-effectiveness both concern the social aspects of feasibility: practicality considers the environment, while cost-effectiveness relates to affordability (Nakata and Weidner, 2012). Finally, social inclusiveness measures how a concept improves the abilities, opportunities, and dignity of disadvantaged persons to participate in society. Further, it reflects the credo of doing no harm to people (Domínguez-Torreiro, 2016; United Nations, 2014).

⁷We approached five new experts with experience in measuring social impact in the humanitarian sector. They were not part of the pyramid search in Phase II, were not originators of a social innovation in Phase III, and did not evaluate the social innovations or the broadcasting submissions.

Table 1. Clustering of Social Innovations Identified via Theory-Guided Search versus Broadcasting into Categories

	Theory-Guided Search (<i>n</i> = 25)		Broadcasting (Benchmark) (<i>n</i> = 60)	
	<i>n</i>	%	<i>n</i>	%
Tangible products	3	.12	26	.43
Nature-based solutions	5	.20	10	.17
Education	1	.04	5	.08
Software and apps	3	.12	10	.17
Community-based solutions	5	.20	7	.12
Service and business models	3	.12	1	.02
Grassroots solutions	5	.20	1	.02
Total	25	1.00	60	1.00

After receiving an oral explanation (Krippendorff, 2004) and written descriptions of all assessment criteria, the four experts evaluated every idea on each criterion using a 5-point Likert scale (from 1 = *very low* to 5 = *very high*). The overall inter-rater reliability between the four evaluators using the average deviation index (Burke and Dunlap, 2002) was .61. Since a value of .8 is considered a reasonable upper-limit cut-off for the index for 5-point items (Burke and Dunlap, 2002), our data have a fair yet acceptable result, given the evaluators' diverse backgrounds, their different perspectives on the topic (humanitarian sector versus engineering), and the cultural distance among the experts (Hofstede, 1993). Thus, we calculated and compared the mean values of all evaluators' assessments on each criterion for all innovations resulting from the theory-guided search and for all innovations resulting from the broadcasting.

The results of this comparison delivered a very consistent picture. As Table 2 illustrates, the innovations surfaced through the developed theory-guided bottom-up search process were evaluated significantly higher than the innovations gathered through the broadcasting approach on all seven abovementioned quality criteria.

Discussion

Despite organizational search's centrality in innovation theories (Laurson, 2012; Nelson and Winter, 1982), there has been little theoretical attention to how innovative search should best take place in different open innovation contexts (Jeppesen and Lakhani, 2010; Lopez-Vega et al., 2016). This

Table 2. Quantitative Comparison of the Quality of the Identified Innovations via Theory-Guided Search versus Broadcasting

	Theory-guided search ($n = 25^a$)		Broadcasting (benchmark) ($n = 60^a$)		Mann–Whitney U -test Z-value (p -value)*
	Mean	SD	Mean	SD	
Technical quality	3.53	.36	2.99	.35	−5.098 (.000)
Novelty	3.32	.64	2.97	.54	−2.306 (.021)
Use value	3.77	.41	3.19	.43	−4.879 (.000)
Feasibility	3.49	.45	2.82	.65	−4.281 (.000)
Social impact	3.50	.46	2.86	.61	−4.359 (.000)
Cost-effectiveness	3.53	.49	2.82	.71	−3.984 (.000)
Practicality	3.33	.47	2.63	.62	−4.490 (.000)
Social inclusiveness	3.65	.66	3.10	.64	−3.230 (.001)
Degree of elaboration	3.24	.57	1.91	.63	−6.219 (.000)
Overall average	3.48	.46	2.78	.45	−5.563 (.000)

^aAll innovations were evaluated by four experts on all criteria.

*We used Mann–Whitney U -tests, since the data were not normally distributed.

is especially true for the humanitarian sector, for which a theory-guided bottom-up search approach for social innovation is theoretically most suitable (Felin and Zenger, 2009, 2014; Ramalingam et al., 2015), while existing research has not made it clear what such a process should best look like and which theory should guide the search. To start addressing this research gap, we have developed a theory-guided bottom-up search process for social innovations in the humanitarian sector using PAR. We will now discuss the key insights derived from our research, especially the answers to RQ1 (*What is an effective theory-guided bottom-up search process for social innovations in the humanitarian sector?*) and RQ2 (*Which theory guides this search?*), which drove this research.

Empirical Support for a Theory-Guided Bottom-Up Search Process

Building on theory of organizational search, we assumed that local knowledge's hiddenness and the complexity of humanitarian problems would mandate a *bottom-up* as well as a *theory-guided* search process to identify social innovations in the humanitarian sector (Felin and Zenger, 2014). Throughout the execution of the PAR, the knowledge's hiddenness and the complexity of humanitarian problems were clear to us. The success of the developed search process in leveraging valuable social innovations delivered first empirical support for the relevance of a theory-guided bottom-up search process for this context. Further, our comparison to a broadcasting search for social innovations delivered first quantitative support for

the theoretical assumption of a *theory-guided* search (Felin and Zenger, 2014). The social innovations surfaced through our theory-guided search process scored significantly higher in terms of both technical quality and social impact compared to ideas identified via broadcasting; further, only a few grassroots and community-based innovations were identified via broadcasting. This shows that a theory-guided search process is better suited to identify solutions developed in local communities than a broadcasting approach, such as an innovation contest, which solely relies on self-selection of innovators (Felin and Zenger, 2014; Nickerson and Zenger, 2004).

The Theory-Guided Bottom-Up Search Process for the Humanitarian Sector

We will now discuss the most significant adaptations we had to make to the well-known lead user method in determining a theory-guided bottom-up search process for the humanitarian sector. A key insight from the development of this search process was that local knowledge's stickiness and hiddenness required for solving this humanitarian problem as well as the problem's complexity were even more severe than expected. This is reflected in the many adaptations that we had to make to the theory-guided bottom-up search process we started with, as we will discuss in some detail in the following sections.

Experiencing even higher levels of hiddenness and complexity is theoretically unsurprising, given that Felin and Zenger's (2014) conceptual classification incorporated a binary distinction (high/low) in its two dimensions knowledge hiddenness and problem

complexity. Clearly, searching for social innovations in the humanitarian sector is thus even higher on the hiddenness and complexity scales than identifying lead user innovations, which are also categorized as complex problems with hidden knowledge (Felin and Zenger, 2014). This insight speaks of the need for a finer-grained categorization on both dimensions in order to allow for a more precise choice of search processes in the user community-driven innovation quadrant. In the case of humanitarian problems' complexity, it may even make sense to speak of *wicked* problems. Wicked problems are characterized among others by circular causality, a lack of well-structured alternative solutions, and a need for constant re-solution (Lukes, 2004; Rittel and Webber, 1973), which is comparable to what we experienced.

Identification of problem drivers became problem understanding (Phase II). The change from identification of trends (i.e., the lead user method) and the identification of problem drivers (i.e., in the PAR planning phase) to problem understanding in Phase II (Figure 1) can be explained in light of the theories on problem framing. Complex or wicked problems are typically associated with a lack of understanding of the underlying variables and their (dynamic) interdependencies (Fernandes and Simon, 1999; Mason and Mitroff, 1981). In other words, as Rittel and Webber (1973, p. 161) noted, "The formulation of a wicked problem *is* the problem!" Thus, a clear distinction between problem formulation (i.e., Phase II) and problem solving (i.e., Phase III) is also necessary (Baer et al., 2013; Lipshitz and Bar-Ilan, 1996) to avoid being solution-minded (Maier and Hoffman, 1960) and swiftly jumping to solutions (Enders et al., 2016). A comprehensive problem formulation integrates various perspectives brought along by problem complexity and is agreed upon via unanimity (instead of majority; Baer et al., 2013). For this purpose, a problem space visualization of the main causes and their development over time, as well as the indication of starting points for de facto solutions can foster understandability among all stakeholders (MacCrimmon and Taylor, 1976; Ramalingam et al., 2008).

Identification of lead users/social innovators became solution search (Phase III). The switch in focus from searching for a specific innovator

(i.e., a lead user or social innovator) to searching for a solution can be explained as follows. Overall, our findings indicated that a guiding theory might require a problem space facet, a solution facet, and an innovator facet, which is in line with a recent call for multiple perspectives in the literature on social innovation (Cajaiba-Santana, 2014). Particularly, we found that a considerable number of identified social innovations represent the characteristics of free innovation (von Hippel, 2016). In contrast to existing theory, however, the free innovations identified through our search showed a comparatively high adoption rate. The adoption of free innovation is generally not self-evident, since benefits to potential new users is an externality for the developer (de Jong et al., 2018; von Hippel, 2016). However, in the humanitarian sector, motives such as altruism, community identification, and ideological considerations seem to lead to better diffusion (de Jong et al., 2018). Thus, starting points for identifying bottom-up solutions to humanitarian problems could be to look for free innovations with a high adoption rate or for free innovators with altruistic motives.

Nonetheless, and in line with the literature, we found not *the* social innovator but a diverse range of different actors who had developed social innovations (The Young Foundation, 2012; van der Have and Rubalcaba, 2016) as well as community innovations that could not be linked to one particular individual (Harris and Albury, 2009). Further, we also noticed that innovators in the humanitarian sector tend to struggle to self-identify as innovators (Lettice and Parekh, 2010) and, thus, were "hard to reach" (Pulford and Addarii, 2010, p. 28). Instead of searching for specific innovators or innovation types, we came to realize that it was best to apply the developed multidimensional problem space as the theoretical representation of the solution landscape to guide our search (Felin and Zenger, 2009). This suggests that, while characteristics of an innovation and an innovator likely serve as additional guidance, a search for social innovations in the humanitarian sector should focus on solutions that fit the defined problem space.

Pyramiding had to be complemented by secondary search (Phases II & III). Unsurprisingly, pyramiding has proved its potential to cross knowledge domains' boundaries (Poetz and Prügl, 2010) and to facilitate

knowledge exchange (Lane and Lubatkin, 1998; Szulanski, 1996). Thus, pyramiding enhanced not only our problem understanding by providing access to various perspectives on the problem in Phase II, but also revealed several useful indirect referrals for our solution search in Phase III. This is interesting, because the established assumption is that pyramiding provides direct referrals to relevant individuals (Stockstrom et al., 2016; von Hippel, 1986). Instead, for the humanitarian sector, our findings assigned a more significant role to referrals to intermediaries such as organizations, events, literature, or solutions (Hyysalo et al., 2015). Thus, it seems that, in the case of wicked problems, pyramiding must be complemented by an extensive secondary search to close gaps between referred intermediaries and persons that can be contacted.

Co-creation became peer-creation facilitation (Phase IV). We learned that peer-creation facilitation among social innovators seems more effective than co-creation among innovators and the searching organization. Again, the need for this adaptation stemmed from problem wickedness and from the unexpectedly high knowledge stickiness in the humanitarian sector. Our findings support the insight that social innovators in the humanitarian sector address wicked problems, for which static solutions that try to “fix” a problem once and for all are ineffective (Dorado and Ventresca, 2013). Instead, “clumsy” solutions developed and constantly adapted by locals seem more appropriate (Rayner, 2006), which emphasizes knowledge stickiness. This notion of dynamic solutions specifically tailored to a local and changing context fits an increasingly acknowledged theme among humanitarian organizations to build resilience, defined as local adaptive agents’ abilities to cope with or adapt to hazard stress (Gunderson, 2003; Pelling, 2003). Thus, resilience emphasizes the need to empower local problem solvers. Our findings reflect the notion of resilience, since most of the identified social innovations aim at flood risk prevention. Thus, peer-creation facilitation as a mode of empowerment that acknowledges the dynamism and context-boundness of social innovations in the humanitarian sector is better suited for building resilience than co-creation.

Further, our insights support calls to form networks of social innovators (Lettice and Parekh, 2010; Pulford and Addarii, 2010). Forming networks among

like-minded peers is necessary to align the various interpretations of and perspectives on wicked problems (Stacey, 2003; Volkema, 1983). Thus, social proximity and interpersonal tie strength can enhance the ease and efficacy of transferring complex tacit knowledge (Hansen, Mors, and Løvås, 2005; Reagans and McEvily, 2003), which—in turn—fosters knowledge transfer by mitigating the negative influences of technological differences or geographic distance (Hansen and Løvås, 2004; Tsai, 2002). A similar notion can be found in the literature on online communities (Pitta and Fowler, 2005).

Implications, Limitations, and Further Research

Theoretical Implications

We have made important contributions to the open innovation literature generally and to the topic of open innovation in the social innovation literature in particular. Concerning *open innovation* generally, we have made three contributions. First, our findings reveal a first detailed suggestion of what a theory-guided bottom-up search process for surfacing social innovations for wicked problems could look like. Thus, we have responded to calls for research into search in open innovation (Felin and Zenger, 2014; Lopez-Vega et al., 2016), especially to investigate the search process in complex systems (Baumann and Siggelkow, 2013). Our study is the first to empirically show how the search mechanism problem framing (Baer et al., 2013) can be applied in such a search process—a frequent request (Baer et al., 2013; Heiman, Nickerson, and Zenger, 2009). Future research can now investigate how the developed search process can be further improved and how it can be used for other complex problems and hidden knowledge, for instance, for identifying bottom-up energy initiatives, which can play key roles in the global energy transition (de Vries, Boon, and Peine, 2016; Nielsen, Reisch, and Thøgersen, 2016).

Second, we have contributed to the emerging body of research on the diffusion motives behind free innovation (de Jong et al., 2018) by introducing triggers that stem from an innovator’s environment and its constraints (Dorado and Ventresca, 2013). It would be valuable to further investigate to what extent these triggers help to overcome market failures of free innovation, increasing social welfare in countries of the both the Global South *and* the Global North.

Third, we have contributed to the emerging body of research on the comparative aspects of governing open innovation (Afuah and Tucci, 2012; Lakhani, Lifshitz-Assaf, and Tushman, 2012). We have contributed by empirically testing and confirming Felin and Zenger's (2014) conceptual model, which suggests that a theory-guided bottom-up search is best suited for solving complex problems with hidden knowledge. Despite the difficulty to measure the exact complexity level (Casti, 1994), further research should include a finer-grained categorization of complexity and hiddenness in order to allow for a more specific fit between search process and problem characteristics, especially for the broad category of user community-driven innovation. Also, we have shown that knowledge hiddenness entails more than the unawareness of its location, but also refers to its stickiness concerning the ease to transfer it. In the same line of reasoning, further research should also continue to compare the different governance mechanisms (Savino et al., 2017), with a particular focus on comparisons between open and closed search mechanisms, to overcome the current limited understanding of the downside of openness (Dahlander and Gann, 2010) and on how to develop an organization's absorptive capacity for recombining the identified knowledge from external sources (Savino et al., 2017).

Concerning the literature on *social innovation*, we have made three contributions. First, we have shown how a theory-guided bottom-up search based on open innovation theory can help to cope with problem wickedness as well as knowledge hiddenness and stickiness in the humanitarian sector, which are considered major barriers to the emergence and diffusion of social innovations (Chalmers, 2013; Shaw et al., 2009). Further research should pursue this avenue by investigating how this search process can be made more effective (e.g., in terms of identifying actionable solutions) and more efficient (e.g., in terms of cost and time) for use by humanitarian organizations.

To this end, we also suggest further looking into the theoretical representations that guide a search for social innovations. To date, boundary spanning commonly involved recognizing and connecting a problem to a particular crowd of solvers (Fleming and Waguespack, 2007; Rosenkopf and Nerkar, 2001). We have shown that a too narrow focus on either the problem space or individuals or innovations may be insufficient for complex problems. This lack of multiple perspectives has recently been pointed out as

a general gap in the literature on social innovation (Cajaiba-Santana, 2014). Further research should build on our notion to combine a problem space facet, a solution facet, and an innovator facet so as to allow for a more holistic theory. To this end, recent research into entrepreneurial innovation has suggested using narratives as a unit of analysis (Garud, Gehman, and Giuliani, 2014).

Second, we have contributed to the social innovation literature by offering new insights about the origin of social innovation, particularly in the humanitarian sector. In doing so we offer a better understanding and thus a more fine-grained definition of social innovation in the humanitarian sector with regard to (i) the motives that trigger the development of social innovations in this sector and (ii) the importance of local empowerment and resilience. With regard to the motives we built on the notion that social innovations in low-income markets address needs triggered by constraints in their environment instead of following a deliberate social mission (Sinkovics, Sinkovics, Hoque, and Czaban, 2015; Sinkovics et al. 2014), which is a common theme in the literature (Cajaiba-Santana, 2014). Further research is now needed to look more closely into this phenomenon to further understand how social innovations in the humanitarian as well as in other sectors evolve, with a specific focus on local settings (Bloom and Betts, 2013).

Third, we have contributed to the literature on social innovation networks and ecosystems. By introducing the concept of peer-creation, we have emphasized the importance of social proximity for complex knowledge transfer and gathering like-minded innovators in mutually supportive communities for the humanitarian sector (Pulford and Addarii, 2010) aligned with the emerging concept of resilience. Currently, social innovators are struggling to connect to appropriate networks, which lowers their morale and hinders access to resources and the scaling up of ideas (Chalmers, 2013; Lettice and Parekh, 2010). Thus, researchers should investigate how humanitarian organizations can—similar to how Hienerth, Lettl, and Keinz (2014) described it—create successful peer-creation ecosystems and facilitate lively, productive interaction among their members.

Practical Implications

Our study findings also have a number of practical implications for humanitarian organizations. First,

to find high quality social innovations, we recommend implementing a *bottom-up* and *theory-guided* search process instead of using a broadcasting approach such as an innovation contest. Based on our findings, we suggest applying a search process with four distinct phases: I. project scoping, II. problem understanding, III. solution search, and IV. peer-creation facilitation (see also Figure 4). For executing these phases, we have the following recommendations:

- *Phase I:* We recommend that managers who seek to address a complex humanitarian problem start the search with a workshop in which all relevant internal and external stakeholders jointly decide about the project scope. Since complexity commonly relates to various interpretations of one situation, we further recommend creating a decision matrix with boundary conditions to align different perspectives by discussing the project scope together, already reducing the complexity upfront.
- *Phase II:* As a next step, we recommend integrating a clear distinction between problem formulation and problem-solving, which is key to fully understanding a complex problem. To this end, we suggest pyramiding, since as it offers great, proven benefits for gathering various knowledge sets. Only when all stakeholders have agreed unanimously on the problem to be solved should the search for solutions start. To support this decision process, we recommend illustrating a problem space in order to reduce the perceived complexity and building a theoretical representation that can guide the search for solutions.
- *Phase III:* For the solution search, we recommend pyramiding complemented by secondary research in order to fill gaps between referred intermediaries and de facto innovators. Also, we recommend shifting the focus away from finding specific innovators toward looking for solutions and validating them by referencing them with the problem space.
- *Phase IV:* Here, we recommend focusing on facilitating peer creation among like-minded social innovators who share a similar perspective on a problem and who further develop their solutions together. To this end, we suggest encouraging knowledge transfer via a virtual or real-world platform to keep in touch with the social innovators and to gain access to improved solutions in the long run.

Critical Reflection and Limitations

We generally sought to minimize the limitations that accompany PAR by thoroughly embedding the results in theory (Greenwood, 2014) and by introducing a standardized method (Levin, 2012). Nonetheless, when critically reflecting on the PAR we conducted (Huang, 2010; Levin, 2012), we must address a number of observations and limitations that need to be considered by future research. First, the PAR was executed by a team of researchers that were external to the humanitarian organization—the IFRC. External individuals have less domain knowledge than internal experts and can therefore help to overcome the internal search bias (Poetz and Prügl, 2010). Further, high domain knowledge may impede creative problem-solving (Wiley, 1998). The researchers' low domain knowledge may thus have had unnoticed mixed effects on the outcome. Therefore, researchers should investigate whether it is best to involve externals in the search for bottom-up social innovations or whether the search is best conducted only by internal actors, or by a combination of the two.

Second, the expert interviews in Phase II took much more time than originally intended. Fortunately, the IFRC—as a highly renowned international organization—was a very helpful facilitator to effectively and efficiently get access to the many more required experts. The unintended extension remained fairly short. For the execution of future PAR in the humanitarian sector, one should consider that smaller and lesser-known organizations may find it hard to contact such a large set of experts; thus, much more time may be required in such a situation. In contrast, relying heavily on the contacts of the IFRC may also have led to a selection bias in identifying experts, which future studies should therefore pay special attention to.

Third, our PAR sought to identify a set of social innovations within a given timeframe with the IFRC, and ended with Phase IV (peer-creation facilitation). Support for the further (facilitation of the) development and distribution of the innovations through the IFRC, PMI, or partners would have been desirable. Humanitarian organizations such as the IFRC however generally don't have the capabilities to support the uptake, further development, and integration of innovations. Therefore, it would have been beneficial if resources and manpower for such an uptake were planned right from the outset.

Finally, our PAR study results are based on a single implementation of the theory-guided bottom-up search process in a single organization. Thus, the findings' generalizability and particularly the applicability of the theory-guided bottom-up search process for similar and very different humanitarian problems need validation. To overcome this, the author team recently started to test this search process' applicability with the IFRC for the complex problem of drought in the Horn of Africa. This and other future studies are needed to achieve a theory-guided bottom-up search process that more generally applies for the search for social innovations in the humanitarian sector.

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Supporting Information

Additional supporting information may be found in the online version of this article at the publisher’s web site:
Online supplement 1: Overview of expert interviews
Online supplement 2: Summaries of selected concepts

Appendix: Overview of Social Innovations

ID	Type of Social Innovation	Source of Social Innovation	Diffusion	Free Innovation ^a	Trigger	Disaster Risk Management Cycle Phase
SI 01	Tangible product	Expert Interview	Province-wide	Free innovation	Environment-related trigger	Preparedness
SI 02	Tangible product	Secondary research	Province-wide	No free innovation	Work-related trigger	Prevention
SI 03	Tangible product	Secondary research	Prototype only	No free innovation	Work-related trigger	Prevention
SI 04	Nature-based solution	Secondary research	Local community	Free innovation	Personal need	Prevention
SI 05	Nature-based solution	Secondary research	Province-wide	Free innovation	Environment-related trigger	Prevention
SI 06	Nature-based solution	Secondary research	Province-wide	No free innovation	Work-related trigger	Response & prevention
SI 07	Nature-based solution	Expert interview	Local community	Free innovation	Personal need	Prevention
SI 08	Nature-based solution	Expert interview	Province-wide	Free innovation	Personal need	Rehabilitation
SI 09	Educational solution	Secondary research	Nationwide	No free innovation	Environment-related trigger	Prevention
SI 10	Apps and software	Secondary research	Nationwide	No free innovation	Work-related trigger	Response & preparedness
SI 11	Apps and software	Secondary research	Prototype only	No free innovation	Work-related trigger	Preparedness
SI 12	Apps and software	Expert interview	Province-wide	No free innovation	Work-related trigger	Response & rehabilitation
SI 13	Community-based solution	Expert interview	Local community	Free innovation	Environment-related trigger	Preparedness & rehabilitation
SI 14	Community-based solution	Expert interview	Nationwide	Free innovation	Personal need	Prevention
SI 15	Community-based solution	Expert interview	Nationwide	Free innovation	Personal need	Prevention & preparedness
SI 16	Community-based solution	Secondary research	Local community	No free innovation	Personal need	Prevention
SI 17	Community-based solution	Secondary research	Nationwide	Free innovation	Environment-related trigger	Prevention
SI 18	Service- or business-model innovation	Secondary research	Nationwide	Free innovation	Work-related trigger	Prevention
SI 19	Service- or business-model innovation	Expert interview	Nationwide	No free innovation	Work-related trigger	Prevention
SI 20	Service- or business-model innovation	Expert interview	Province-wide	Free innovation	Environment-related trigger	Prevention
SI 21	Grassroots solution	Expert interview	Local community	Free innovation	Personal need	Response
SI 22	Grassroots solution	Expert interview	Local community	Free innovation	Personal need	Preparedness
SI 23	Grassroots solution	Expert interview	Local community	Free innovation	Personal need	Prevention
SI 24	Grassroots solution	Expert interview	Local community	Free innovation	Personal need	Prevention
SI 25	Grassroots solution	Expert interview	Local community	Free innovation	Personal need	Prevention

^aFree innovation definition according to von Hippel (2016).